

WHAT IS CLAIMED IS:

1. A semiconductor device comprising a first Cu interconnection including additive metal atoms and additive silicon atoms, wherein a density of said additive metal atoms is higher in vicinities of bottom and side surfaces of said first Cu interconnection than in a vicinity of a top surface thereof, and a density of said additive silicon atoms is higher in said
5 vicinity of said top surface than in said vicinities of said bottom and side surfaces.
2. The semiconductor device according to claim 1, wherein said additive metal atoms include atoms of one or more of metals selected from the group consisting of Al, Sn, Ti, Si, In, Ag, Zr, Ni, Mg, Be, Pd, Co, B, Zn, Ca, Au and Ga.
3. The semiconductor device according to claim 1, further comprising a second Cu interconnection overlying said first Cu interconnection and including additive metal atoms and additive silicon atoms, wherein a density of said additive metal atoms in said second Cu interconnection is
5 higher in vicinities of bottom and side surfaces of said first Cu interconnection than in a vicinity of a top surface thereof, and a density of said additive silicon atoms in said second Cu interconnection is higher in said vicinity of said top surface than in said vicinities of said bottom and side surfaces.

4. The semiconductor device according to claim 3, wherein said additive metal atoms in said second Cu interconnection include atoms of one or more of metals selected from the group consisting of Al, Sn, Ti, Si, In, Ag, Zr, Ni, Mg, Be, Pd, Co, B, Zn, Ca, Au and Ga.

5. The semiconductor device according to claim 3, wherein said second Cu interconnection includes a Cu interconnection line and a via plug extending from said Cu interconnection line and connected to said first Cu interconnection.

6. The semiconductor device according to claim 3, wherein said first Cu interconnection and said second Cu interconnection are connected together via a Cu plug covered with a barrier metal film.

7. A method for manufacturing a semiconductor device comprising the steps of:

forming a Cu film on top of a seed film including Cu and an additive metal;

5 diffusing said additive metal in said seed film into said Cu film; and
diffusing silicon atoms into said Cu film through a top surface thereof.

8. The method according to claim 7, wherein said silicon atoms diffusing step comprises the step of irradiating silane onto said Cu film.

9. The method according to claim 8, wherein said irradiating step is performed after said Cu film is configured as Cu interconnections.
10. The method according to claim 7, wherein said seed film comprises said additive metal at 0.1 to 1.5wt%.
11. The method according to claim 7, wherein said seed film comprises Al as said additive metal at a weight percent lower than 1% and not lower than 0.1%